

THERMOELECTRIC CHILLER/WARMER OF CONTAINED SUBSTANCE

FIELD OF INVENTION

[0001] The present invention relates to thermoelectric chillers and warmers, and more particularly to devices which can increase or decrease the temperature of any contained liquid such as a bottled or canned liquid or any solid and liquid in combination, and/or can maintain the temperature of the liquid or solid.

BACKGROUND OF THE INVENTION

[0002] Thermoelectric chillers and warmers of various types are known in the art. Such devices are typically used in restaurants or homes to quickly chill or warm a drink or food substance, such as for example, a bottle of wine.

[0003] However, previous chilling/warming devices have some inherent disadvantages. One of the disadvantages with existing devices is that they do not evenly regulate the temperature of the bottled or canned beverage that is placed inside of them. Another disadvantage is that they cannot adequately regulate the chilling or warming process to a desired selected temperature and maintain that consistent temperature for extended periods of time.

[0004] The present invention overcomes these and other problems inherent in existing chilling/warming devices. The present invention provides a warming/chilling device that is, in one form of the invention, a thermoelectric chiller and warmer which can decrease or increase the temperature of a contained liquid or solid such as a bottled or

canned liquid and/or solid. In one embodiment, the thermoelectric chiller/warmer is equipped with one or more cylinders into which containers, such as for example, bottles can be inserted. Also, a cover may be supplied to enclose the air space around the container located in a cylinder so that moisture is prevented from entering the air space. In one form of the invention, means for providing uniform cooling/warming of the liquid/solid is further provided.

OBJECTS OF THE INVENTION

[0005] It is an object of the present invention to provide a thermoelectric wine chiller equipped with one or multiple cooling cylinders into which wine bottles can be inserted.

[0006] Another object of the present invention is to provide a thermoelectric wine chiller having a means of facilitating cooling or warming of a substance.

[0007] It is a further object of the present invention to provide a thermoelectric chiller/warmer with a means of controlling the desired temperature of a substance.

[0008] It is a further object of the present invention to be able to chill/or warm two bottles simultaneously at an equal cooling rate.

[0009] It is a further object of the present invention to provide a thermoelectric chiller with a means of enclosing the air space around a bottle so that moisture is prevented from entering the air space and preventing moisture condensation inside the cooling zone.

[0010] It is yet another object of the present invention to provide the means of making the chilled/warmed substance temperature uniform.

[0011] It is yet another object of the present invention to provide a thermoelectric chiller/warmer capable of drawing heat from the second cooling/warming cylinder into the main cooling/warming cylinder so that the second cooling cylinder also chills/warms the second substance at a different temperature than the main cylinder.

[0012] It is yet another object of the present invention to provide a cooling cylinder, the cross-section of which is round, square or any other configuration made of thermally conductive material such as aluminum or copper, and the end of the cylinder is closed with the similar thermally conducting material.

[0013] It is yet another object of the present invention to provide a cooling cylinder thermally insulated around its external walls and the external bottom wall.

[0014] It is yet another object of the present invention to provide a cooling cylinder capped with a thermally insulated cover with which the enclosure of the wine bottle becomes sealed.

SUMMARY OF INVENTION

[0015] At times it is desired to chill or warm liquid or liquid and solids which are either sealed in a container or stored in an open container. In one form of the invention, a thermoelectric chiller and warmer which can decrease or increase the temperature of a contained liquid or solid such as a bottled or canned liquid and/or solid. In one embodiment, the thermoelectric chiller/warmer is equipped with one or more cylinders into which containers, such as for example, bottles can be inserted. Also, a

cover may be supplied to enclose the air space around the container located in a cylinder so that moisture is prevented from entering the air space. A means for providing uniform cooling/warming of the liquid/solid is also provided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] Fig. 1 is a perspective view of one embodiment of the present invention having two cylinders shown with one cover off of one of the cylinders exposing a bottle exposing inserted in that cylinder.

[0017] Fig. 2 is a cross-sectional view of one embodiment of the present invention as viewed in the direction of A – A of the invention of Fig. 1.

[0018] Fig. 3 is a top cross-sectional view of another embodiment of the present invention.

[0019] Fig. 4 is a top cross-sectional view of another embodiment of the present invention whereby two cylinders are temperature regulated via a single thermoelectric module.

[0020] Fig. 5 is a top cross-sectional view of yet another embodiment of the present invention whereby two cylinders are temperature regulated via a single thermoelectric module.

[0021] Fig. 6 is a side cross-sectional view of another embodiment of the present invention whereby the thermoelectric module, the heat sink and the fan are located at the bottom portion of the chiller/warmer device.

[0022] Fig. 7 shows a perspective view of another embodiment of the present invention having one cylinder and with a cover in place over the cylinder.

[0023] Fig. 8 is another view of the thermoelectric chiller/warmer of FIG. 7 with the cover removed from the cylinder exposing a bottle inserted in that cylinder.

[0024] Fig. 9 is a top cross-sectional view in the direction of C - C of one embodiment of the present invention as shown in Fig. 8 but with a different shaped outer casing than the embodiment illustrated in Fig. 8.

[0025] Fig. 10 is a top cross sectional view taken along direction C - C of the embodiment shown in Fig. 8.

[0026] Fig. 11 is a side cross sectional view in the direction of D - D in Fig. 8 shown with the addition of a motor.

[0027] Fig. 12 is a cross-sectional view of one embodiment of a cover of the present invention.

[0028] Fig. 13 is a perspective view of one embodiment of a base of the present invention.

[0029] Fig. 14 is a perspective view of one embodiment of the present invention shown sitting on the base of FIG. 13.

DETAILED DESCRIPTION OF THE INVENTION

[0030] The following terms and definitions will be used through this written description. Bottles, cans and containers of all kinds containing wine or other liquids or solids may be referred to as “bottles”. Although the present invention applies to both a chiller and warmer device, it may be collectively be called a “chiller”, since the chiller becomes the warmer by simply switching the polarity of the DC electrical power or vice versa. Cooling/warming may be collectively called “cooling” or “warming”. Although

the present invention applies to any liquid, the liquids are collectively called “wine”. The device that holds the liquid or solid may be called bottle or container or other device. In all embodiments herein described, any singular item is construed also as multiple items without any specific qualifications. For example, any “cooling cylinder” may also be defined as “cooling cylinders”. Also, a “thermoelectric module” may also be defined as “thermoelectric modules”. Further, components shown in the various drawings and/or described herein may be interchangeable with the various embodiments of the present invention even though a particular component(s) may not be described in relation to a specific embodiment.

[0031] One embodiment of the 2-cylinder type thermoelectric wine chiller 5 is shown in Fig. 1. Its main body 1 is configured substantially in the shape shown in Fig. 1 however it can be shaped in virtually any other shape. Main body 1 has a cavity within a cooling cylinder 4 to receive a wine bottle 3. A cover 2 is provided that is constructed of an insulating material and/or plastic or metal or other material and may be transparent or opaque, covers the remaining portion of the bottle 3 projecting outside of cylinder 4 in the ambient air after the bottle 3 has been inserted and thus, the bottle 3 is completely enclosed from the ambient air.

[0032] The cross-section of the embodiment of Fig. 1 viewed in the direction of A – A is shown in Fig. 2. As shown in Fig. 2, the ambient air is drawn by fan 6 from a first side 1A of the casing of the main body 1 and discharged from the second side 1B. The cooling cylinder 34 may be used for chilling an unopened or opened bottle of wine. In one embodiment, the main cooling cylinder 34 has a wall thickness of approximately 1 mm – 6 mm or more, made of thermally conductive material such as aluminum or copper,

the length of which ranges approximately from 60% through 90% of the length of the bottle. The bottom of the cylinder 34 is formed by the same thermally conductive material or other material. The cooling cylinder 34 has a land area or contact area 35 protruding from the cooling cylinder 34 along the length of the cylinder 34. Contact area 35, in one embodiment, may be machined to a high grade smooth finish to maximize the surface-to-surface contact between area 35 and a thermally conductive spacer 37. In one embodiment, contact area 35 is an integral part of cylinder 34 but in other embodiments contact area 35 and cylinder 34 may be comprised of two or more components. Cavity 36 is formed as a result of closing off the bottom of the cylinder 34 and is used for receiving and holding the wine bottle 3. In one embodiment, a thermally conductive spacer 37 is operably connected to the land area 35 by a fastener 38, such as for example, screws. A thermoelectric module 10 is located between the spacer 37 and a heat sink 41 and may be joined using a fastener 40, such as for example, screws. The external casing 31 encloses the entire wine chiller 25. In one embodiment, a cavity 50 created between the casing 31 and the above internal assembly may be filled with a thermally insulating material 42. In one form of the invention, the thermoelectric module 10 is a solid state heat pump, which consists of numerous semi-conductor pairs, N-type and P-type, connected in series between the ceramic substrates. Upon applying DC power through the series connected semi-conductor pairs of the thermoelectric module 10, one of the two ceramic substrates reduces in temperature and gets cold while the other increases in temperature and gets hot evidencing that a heat pumping/transfer action is generated from the cold ceramic substrate to the hot ceramic substrate. The cold substrate absorbs heat first from the spacer 37, then from the cooling cylinder 34. The sum of the input power

and the thermal energy transferred from the cooling cylinder 34 is dissipated from the heat sink 41 with the help of a fan 6. Elongated pads 44 are disposed inside cylinders 34 and 46 and may be made of a sponge-like material which serves to push the wine bottle 3 located in the cooling cylinder 34 toward the cylinder's coldest wall so that the cylinder wall 34 and wine bottle 3 are in contact. Pad 44 is flexible so that pad 44 makes self-adjustments to accommodate slightly different diameters of wine bottles 3. In another embodiment of the present invention, a pad 44 made of a sponge-like material, soft rubber or cork material is adhered to the internal surface of the cooling cylinder along the longitudinal direction at the opposite side of the cylinder where the direction of the thermoelectric module is located so that the pad pushes the wine bottle toward the thermoelectric module. In yet another embodiment of the present invention, the thermoelectric chiller is provided with a base which will support it at angles in the upright position. In another embodiment of the present invention, a wine bottle sits on the base which rotates within the bottom-less cooling cylinder.

[0033] The natural convection heat transfer and its effect on the movement of the wine inside bottle 3 is realized. Under a situation where the wine bottle 3 shown, for example, in Figs. 1, 8 and 11 is located at the center of the cooling cylinder 34, there is a substantially uniform thickness of the airgap around bottle 3. In one embodiment, a symmetric configuration is realized. Under the symmetric situation, the wine being in contact with the internal surface of bottle 3 is uniformly chilled around bottle 3 circumference. The chilled wine in the immediate vicinity of the internal wall of the bottle 3 will move toward the bottom of bottle 3 uniformly. Thus, the cold wine accumulates at the bottom uniformly causing a stratification in temperature of wine: cold

wine at the bottom and warm wine near the top of the bottle. This stratification in temperature is undesirable to wine lovers. To avoid the symmetric situation an asymmetrical situation must be created. The asymmetrical situation can be generated, when bottle 3 is forced to make contact with the cooling cylinder 34, preferably where the thermoelectric module 10 is closely located. When this happens, the wine in bottle 3 nearest to and touching the cooling cylinder 34 is colder than that of the wine at the opposite side of the bottle 3. As a result of the colder temperature, the wine in bottle 3 closest to the cold area moves toward the bottom of the bottle because it is heavier than the warmer wine due to its higher density. This downward movement of wine pushes and causes the wine at the opposite side of the bottle that has a lower density and is, thus lighter than the colder wine, to be displaced and move upward. The warm wine near the top of the bottle 3 is now replaced with the cold wine that has moved downward. This chain of events generates a continuous movement of wine within bottle 3, which will contribute to making the wine temperature uniform preventing stratification in temperature of the wine from occurring.

[0034] In one embodiment, the main cooling cylinder 34 has an elongated protrusion 45, which may be an integral part of the main cooling cylinder 34 or a separate part to be joined mechanically with cylinder 34. At one end of protrusion 45, a second cooling cylinder 46 is either in contact with protrusion 45 or the two may be mechanically joined. The second cooling cylinder 46 is used for cooling bottled wine that requires less cooling, for instance, a red wine needs to be maintained only at near 20 C whereas a white wine may require cooling to a lower temperature. By making the width and length of protrusion 45 vary, the differential of temperature or coldness of the

second cylinder can be adjusted. The width of protrusion 45 ranges from 10 mm to 20 mm or more. In some applications, the protrusion 45 width may be less than 10 mm. Pad 47 functions as a pusher or positioner of the bottle 3 similarly to pad 44. An AC/DC converter 48 may be provided when an AC power source is used. The AC/DC converter 48 can be removed from the main body 31 as a separate component.

[0035] The embodiment shown in Fig. 3 is identical to the embodiment in Fig. 2 except that the ambient air is drawn from the back side of body 1C and discharged from the second side of the main body 1B. In the embodiment shown in Fig. 4, a twin cooling cylinder 54 has a common land area 35 on which the spacer 57 is fixed by connectors 58, such as for example screws. The thermoelectric module 10 is located between a heat sink 61 and a spacer 57 to be joined by fasteners 60, such as for example screws. A fan 6 draws ambient air from one side of a casing 51 and discharges air from another side of casing 51. As such, the twin cooling cylinders 54 are cooled at equal rate. An AC/DC converter 59 is located downstream of the fan 6 so that the converter 59 cools off in part because of the air flow generated by fan 6.

[0036] The embodiment shown in Fig. 5 is identical to the embodiment of Fig. 4 except that the ambient air is drawn from the back of casing 51 of the main body and discharges from both sides of casing 51. The embodiment shown in Fig. 6 is identical to the embodiment shown in Fig. 5 except that the thermoelectric subassembly comprising the thermoelectric module 10, the spacer 57 and the heat sink 61 is positioned at the bottom portion of the twin cooling cylinders 54 substantially as shown in Fig. 6.

[0037] Fig. 6 is a side cross-sectional view of another embodiment of the present invention whereby the thermoelectric module, heat sink, and fan are located at the

bottom portion of the chiller/warmer device. In this embodiment, air is drawn in through the bottom of casing 51 and discharged from the sides of casing 51.

[0038] The embodiment shown in Fig. 7 has one cooling cylinder 70 and the casing of the main body 71 has a shape substantially as shown in Fig. 7 with cover 2 in place. The ambient air is drawn from one side of the casing 71 and discharged from the other side in casing 71. This embodiment and alternate embodiments function substantially similar to the various embodiments discussed herein.

[0039] The embodiment shown in Fig. 8 is identical to the embodiment of Fig. 7 with the cover 2 removed from the main body 71. In this embodiment, the ambient air is drawn from the center back-portion of the casing 71 and discharge from the side or sides of casing 71. This embodiment and alternate embodiments function substantially similar to the various embodiments discussed herein.

[0040] Fig. 9 is a top cross-sectional view in the direction of C - C of one embodiment of the present invention as shown in Fig. 8 but with a different shaped outer casing than the embodiment illustrated in Fig. 8. The cooling cylinder 84 has a protruded land area 85 and a spacer 87 is joined to the land area 85 by connectors 82, such as for example screws. The thermoelectric module 10 is located between spacer 87 and heat sink 80 and connected mechanically via fasteners 86, such as for example screws. The ambient air is drawn from one side via a fan 83. The AC/DC converter 88 is located downstream of fan 83 and is cooled off by air flow generated by fan 83. A pad 90 is also shown in FIG. 9 to position a wine bottle.

[0041] Fig. 10 is a top cross sectional view taken along direction C-C of the embodiment shown in Fig. 8 in which the ambient air is drawn from the center of the

back of casing 71 by a fan 92 and discharged from both sides of casing. 71. Cavity 96 is disposed between the casing 71 and the cooling cylinder 94 and may be filled with a thermally insulating material 96. The pusher pad 95 functions in substantially the same way as in other embodiments disclosed herein.

[0042] The embodiment shown in Fig. 11 is the cross section of the embodiment shown in Fig. 8 viewed in the direction of D – D except that a motor 104 is included and the wine bottle 3 sits on a rotating plate 105 having a cushion 106, which is driven by means of an electric motor 104 having a fan 12. The rotation of the wine bottle 3 makes the heat transfer effect more efficient and also enhances the mixing of the wine to reduce the stratification of wine in temperature. The ambient air is drawn from the back of the casing 71 and discharged from both sides of casing 71. The AC/DC converter 107 is located adjacent heat sink 103.

[0043] Fig. 12 shows the cross-section side view of one embodiment of a cover 2. The cover 2 functions, as is so named, as a cover to put on top of a cooling cylinder of the main body 71 or other main body to complete the enclosure of a wine bottle 3. The cover 2 snugly fits with the cooling cylinder of the main body to seal the cylinder so that the ambient air moisture will not get into the cooling cylinder to be condensed or frozen. The cover 2 can be made of a single thermally insulating material, or as shown in Fig. 12, it can be assembled of a variety of different components as the internal shell 113 and the external shells 114 of cover 2. A cavity 112 may be filled with a thermally insulating material. When the cover 2 is put on over a cylinder, it encloses the entire bottle 3 and the air trapped in the cooling cylinder is separated from the

ambient air. In one embodiment, the thermally insulated cover is joined with the insulated cylinder via a press fit type fitting or any other means.

[0044] Fig. 13 shows a wedge-like base 121 upon which the entire chiller/warmer system sits at an angle from an up-right position. The embodiment shown in Fig. 14 is equipped with the base 121. In this embodiment pads 90 may or may not be provided.

[0045] In one embodiment of the present invention, the cooling cylinder, the cross-section of which is round, square or any other configuration, is made of thermally conductive material such as aluminum or copper, and the end of the cylinder where a bottle may rest is formed with a similar thermally conducting material. In another embodiment of the present invention, the cooling cylinder is thermally insulated around its external walls and the external bottom wall. In yet another embodiment of the present invention, the cooling cylinder has a step-up land area. A spacer of thermally conductive material and the thermoelectric module are located between the land area and the heat sink to join the three components mechanically.

[0046] In a further embodiment of the present invention, there are more than one cooling cylinders, the main cooling cylinder of which has arms extended outwardly, either integral with the cylinder or thermally conductive pieces mechanically joined with the cylinders, the ends of which are joined with the second and third cylinders. In yet another embodiment of the present invention, the second and third cooling cylinder are made of material that exhibits less conducting characteristics than the main cooling cylinder material. In another embodiment of the present invention, two or more cooling

cylinders are cooled via a common thermoelectric module. In an alternate embodiment, the external appearance of the entire system is in the shape of a large wine bottle.

[0047] Specific embodiments of novel methods and apparatus for construction of novel Thermoelectric Chiller/Warmer of Contained Substance according to the present invention have been described for the purpose of illustrating the matter in which the invention is made and used. It should be understood that the implementation of other variations and modifications of the invention and its various aspects will be apparent to one skilled in the art, and that the invention is not limited by the specific embodiments described. Therefore, it is contemplated to cover the present invention any and all modifications, variations, or equivalents that fall within the true spirit and scope of the basic underlying principles disclosed and claimed herein.